Standardizing Medication Error Event Reporting in the U.S. Department of Defense

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Abstract

Soon after the 1999 Institute of Medicine report, *To Err Is Human*, was released, the Department of Defense (DoD) began an aggressive examination of medical errors and the strategies for minimizing them. A primary goal was the creation of a standardized medication event reporting system, including a central registry for the compilation of reported data. This paper describes important experiences gleaned from the DoD's transition to a standardized medication error reporting system. MEDMARX[SM], an Internet-based commercial reporting application, was selected by the DoD leadership as the standard tool for medication event reporting. MEDMARX was implemented initially at five military hospitals in fall 2000 as part of a patient safety pilot project, and was later made available to all 143 military treatment facilities worldwide. Medication errors represent approximately 50 percent of all patient safety events reported by military health care facilities. Although the challenges associated with the implementation of a standardized error reporting system were considerable in number and scope, the long-term benefits to the DoD are significant.

Introduction

In fall 1999, the Institute of Medicine (IOM) released its groundbreaking report, *To Err Is Human,* which estimated that the annual number of deaths in the United States due to medical errors is between 44,000 and 98,000. This number far exceeds the annual number of deaths resulting from AIDS, breast cancer, or motor vehicle accidents and elevates medical errors to one of the Nation's most urgent, widespread public health problems.[1] As a result, many health care organizations, including the Department of Defense (DoD) Military Health System (MHS), began an aggressive examination of medical errors and the strategies to minimize or eliminate them.

Errors involving prescribed medications account for a significant percentage of the total patient safety events reported by civilian health care facilities and represent approximately half of all errors reported in DoD. While the vast majority of medication errors do not result in adverse patient outcomes, various studies have determined that a significant number of such events do have the potential to cause serious patient harm or loss of life. One study estimates that 7,000 deaths per year are attributable to preventable medication errors, while another study found that nearly 10 percent of all hospital admissions are related to problematic use of pharmaceuticals.[1–3] Health care professionals are encouraged to report medication errors and adverse drug reactions through several established

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programs. The MedWatch program coordinated by the U.S. Food and Drug Administration (FDA) and the Medication Error Reporting (MER) program coordinated by United States Pharmacopeia (USP) and the Institute for Safe Medication Practices (ISMP) are two such programs.[4, 5] The detection and subsequent reporting of medication errors ideally should involve several strategies, including observational methods, computerized triggers, retrospective chart reviews, and spontaneous reporting. However, the systems used to report such events often are organized around spontaneous reporting and are limited by the small percentage of total errors that are actually reported. Error detection methods such as the passive surveillance of electronic pharmacy and medical record data may offer advantages over spontaneous reporting systems, because of their ability to detect possible events that would otherwise go unnoticed or unreported. These methods should be used in tandem to provide a better understanding of error causation and patterns of occurrence.[6] Another limitation to many types of reporting systems is the inability of an individual reporting an event to retrieve or review the report, once it has been submitted.

The timely and accurate reporting of medical errors should be an essential part of a health care organization's overall risk-reduction strategy.[1] Medical error reporting has focused historically on the individuals involved, rather than the systems and processes that allowed the error to occur. Although physicians, nurses, and other caregivers believe the safety and well-being of the patient is their number-one priority, the fear of malpractice lawsuits, public embarrassment, disciplinary action, and loss of credibility has made these same professionals reluctant to report or discuss error-related incidents with others.[6, 7] One possible approach to improving medical error reporting in health care facilities involves the use of anonymous, standardized reporting systems. These systems may help to foster the kind of nonpunitive environment where caregivers can report and share their experiences involving medication errors freely, without fear of reprisals. Additionally, standardized reporting would ensure consistency throughout a health care organization and would enable internal tracking, trending, and comparative analyses. To that end, Federal legislation has been introduced to facilitate the creation of a voluntary system for reporting medical errors and near-miss incidents as a means of further emphasizing the national significance of this issue.[8] The proposed plan also would establish a national patient safety database for the purpose of analyzing error reports and recommending optimal patient care practices.

The Department of Defense response

Soon after the IOM report was released, former President Clinton directed all Federal agencies involved with health care to develop action plans for reducing medical errors. In response to the President's mandate, the Quality Interagency Coordination Task Force (QuIC) released a report in February 2000 titled *Doing What Counts for Patient Safety: Federal Actions to Reduce Medical Errors and Their Impact*.[9] The DoD then assembled a multidisciplinary health care team comprised of Army, Navy, and Air Force representatives to address patient safety

issues within the MHS. Among the team's primary goals was the creation of a system to standardize medical error event reporting among the three services, with all collected data flowing into a centralized data registry. To that end, the DoD initiated a patient safety pilot program in December 2000 at five military hospitals that included the use of the MEDMARX[SM] reporting software system (United States Pharmacopeia, Rockville, MD) for standardized medication error data collection.

MEDMARX, an anonymous and Internet-based database application, was designed to report, track, and detect trends in medication errors within health care organizations. This sophisticated instrument uses standardized drop-down boxes, selection lists, and robust reporting capabilities to streamline data entry, compilation, and retrieval tasks. MEDMARX also permits users to draw comparisons between their hospital or clinic and others like it, using a national facilities database. Moreover, it allows users to perform proactive reviews of error information from other MEDMARX subscribers, in an effort to learn from strategies and mistakes that occurred previously in other health care facilities throughout the Nation.[10]

MEDMARX incorporates a standardized taxonomy and definitions established by the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP). A severity index scale based on patient outcomes allows users to break down actual and potential errors occurring in their facility, according to the threat level to the patient. This index scale ranges in event severity from Category A (a potential error), through Category I (a medication error that may have resulted in a patient death).[11] There are 13 required data elements in the MEDMARX system, including medication use process node, type of error, cause of error, and contributing factors. MEDMARX further includes 30 additional data fields that permit users to track details such as "actions taken to avoid similar errors," "level of staff involved in the error," "error result on patient care," and "medical devices involved in the error." All the data elements are searchable by means of the powerful report functions within the MEDMARX system, and users can use the numerous predefined reports, graphs, and charts to produce aggregate reviews and analyses of the data from their facility. Custom and ad hoc reporting features are also included. MEDMARX further includes a unique "drill down" feature that permits users to convert an on-screen display of graphed or charted errors to a data spreadsheet. The user then can select a single error from the spreadsheet and view all the pertinent details from the incident in report form.[10]

Centralized reporting

The DoD Patient Safety Center (PSC), located within the Armed Forces Institute of Pathology in Washington, DC, was created under the 2001 National Defense Authorization Act to provide the DoD with centralized patient care error reporting and management services. A centralized medical event data registry incorporating the use of MEDMARX was established at the DoD PSC in

November 2002, and use of the software has increased at DoD health care facilities throughout the past 2 years. Additionally, USP has created a self-paced online tutorial for MEDMARX and was contracted to train various DoD patient safety managers in the program's use. In addition to collecting medication-related events, the DoD PSC also receives monthly summary reports from each facility on all other health care-related patient safety events, as well as root-cause analyses.

With the DoD's decision to adopt MEDMARX as the standardized reporting system for medication errors came the need for additional system functionality to permit data sharing and evaluation between military treatment facilities (MTFs). USP was contracted to develop the MEDMARX Multi-Facility Module, which enables health care networks to track medication errors and identify trends at facilities within their systems. This module was introduced in December 2002, and since that time, all military hospitals and clinics have been linked in a sophisticated electronic network that provides the Army, Navy, and Air Force with improved access to medication error information from their individual facilities. The MEDMARX Multi-Facility Module also contains a health management tier that provides the DoD PSC with access to all military medication errors reports, and enables numerous health care systems to be organized under a single management structure. The MEDMARX reporting system and Multi-Facility Module implementations are expected to enhance reporting compliance and accuracy, while facilitating the development of better care practices and policies designed to reduce errors and improve the safe delivery of care in the MHS.

Results

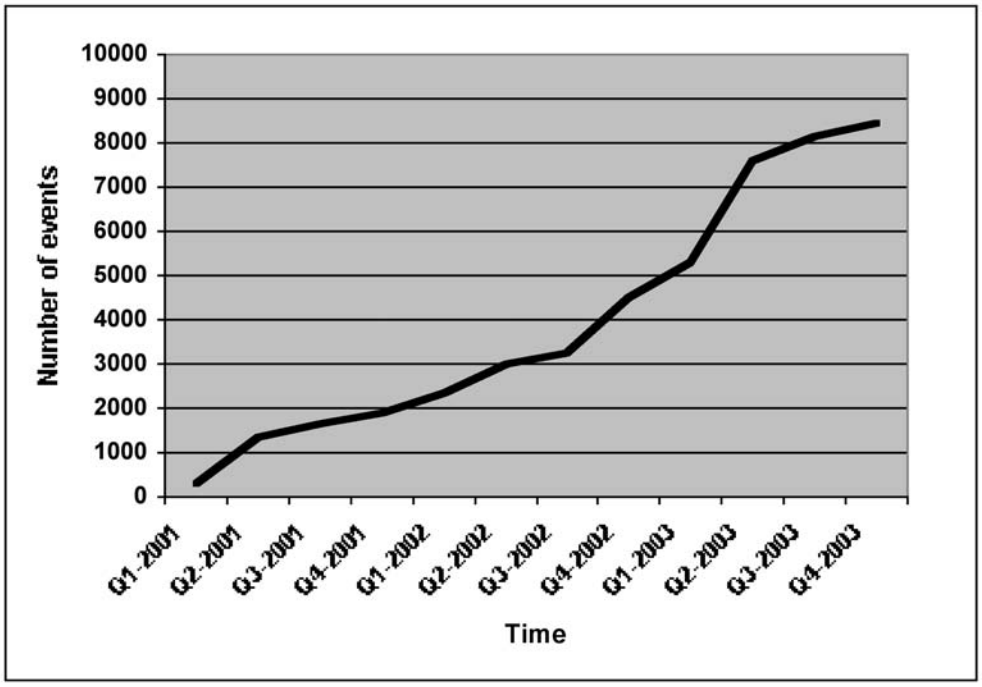
It is important to understand that the data presented in this article are preliminary and have been included primarily for illustrative purposes. Advanced MEDMARX system training for DoD personnel commenced in December 2003, and many MTFs are currently in the program implementation phase.

Reporting volume

The MEDMARX Multi-Facility Module is used to aggregate and analyze data from medication error events that occurred at DoD health care facilities. Several MTFs began using the MEDMARX reporting system early in 2001; since that time, the number of medication errors reported through the MEDMARX system has increased dramatically (Figure 1). Medication-related error events accounted for approximately 50 percent of all DoD patient safety events included in this sample.

MEDMARX system data have indicated a total of 29,662 medication events were reported by staff at DoD facilities between October 2002 and September 2003. This figure includes actual medication error events (defined by the DoD as errors that reach the patient) and near misses (defined by the DoD as events that are corrected through some type of intervention before they reach the patient).

Figure 1. Total number of medication events reported to the Department of Defense Patient Safety Center Registry by quarter from October 2001 through September 2003



Of all medication-related incidents reported, 69 percent were categorized as near misses and 31 percent were categorized as actual events. Of the actual events, 26 percent involved female patients, 22 percent involved male patients, and 52 percent involved patients whose gender was not indicated by the individual who made the report. The last statistic is not surprising, because patient gender is not a required reporting field. Events also were stratified by age. Of the reported events that reached the patient, 18 percent occurred in patients ages 5 years or younger, 6 percent occurred in patients between the ages of 6 and 17 years, and 24 percent occurred in patients between 18 and 45 years of age. Another 24 percent of the medication errors occurred in patients between the ages of 46 and 64 years, while 28 percent occurred in patients 65 years of age and older. Of the reports in which possible patient harm may have occurred, 21 percent of the events occurred in patients 5 years of age or younger, 6 percent of the errors occurred in patients between 6 and 17 years, and 29 percent occurred in patients between 18 and 45 years. Another 20 percent of the medication errors occurred in patients between 46 and 64 years, while 24 percent occurred in patients 65 years of age and older.

Available 2002 MEDMARX national data indicate that approximately 35.5 percent of actual events occurred in patients 65 years of age and older. Of the total events that indicated possible patient harm, 36.4 percent occurred in this population.[12] A more thorough analysis of the DoD and national data, with comparisons to at-risk populations such as pediatrics and geriatrics, was not practical and was beyond the scope of this article. However, this will certainly be a key area for future research.

As of this writing, a total of 143 DoD facilities have the capability of entering data into the MEDMARX reporting system. The number of facilities that used MEDMARX to report at least one medication error in any given month ranged from 84 MTFs to 119 MTFs. Monthly reporting volumes also varied considerably. Some MTFs routinely reported five or fewer medication events per month, while others consistently reported more than 100 monthly events. This variability also was observed between facilities of similar type and bed count. Because all reports to the DoD PSC are made anonymously, no distinguishing facility characteristics other than bed count and facility type are available. This lack of characteristics serves to limit further analysis.

Harm stratification

The MEDMARX reporting system allows users to categorize the error by setting (i.e., inpatient or outpatient). This variable is termed the "source of record." Medication errors submitted to the DoD PSC were stratified by source of record and were further categorized according to patient outcome (i.e., near miss; error, no harm; and error, harm) before being compared with the national MEDMARX system data submitted during calendar year (CY) 2002. The majority of reported errors in the DoD and national datasets for outpatient events were classified as near misses. The majority of reported DoD inpatient errors were classified as no-harm events, while the majority of nationally reported events were classified as near misses. The percentage of inpatient errors that caused harm in DoD was very similar to the national data. The percentage of outpatient errors in DoD that resulted in patient harm was 0.3 percent, compared with 1.4 percent in the national data (Table 1). Additionally, there was an upward trend in the monthly volume of actual and near-miss events reported to the PSC during the same time frame.

The medication use process

The medication use process is divided into five phases or nodes: prescribing, documenting/transcribing, dispensing, administering, and monitoring. All actual medication events (Categories B–I errors, according to the NCC MERP) originate in one of these five nodes. Medication events were stratified by the source of record (inpatient or outpatient). DoD data from the period of October 2002 to September 2003 was compared to the national data submitted to the MEDMARX system during CY 2002 (Table 2). The data reported to the DoD PSC showed the largest percentage of inpatient events had occurred in the administering node (41 percent), followed by those errors that occurred in the dispensing node (26 percent), and those from the documenting/transcribing node (19 percent). The national dataset indicated that the largest percentage of inpatient errors had occurred in the administering node (35 percent), followed by those errors that occurred in the documenting/transcribing node (24 percent), and those from the prescribing node (21 percent).

Table 1. Percentage of inpatient and outpatient events, stratified by harm and reported to the DoD Patient Safety Center Registry, October 2002 to September 2003, with comparison to the 2002 MEDMARX℠ national database

	Inpatient		Outpatient	
Harm stratification*	**DoD**	**National†**	**DoD**	**National**
Near miss‡	40.3%	50.5%	74.7%	60.7%
Error, no harm§	57.9%	47.8%	25.0%	37.9%
Error, harm**	1.8%	1.7%	0.3%	1.4%

* Based on National Coordinating Council for Medication Error Reporting and Prevention error categories. A near miss includes Categories A and B events; error, no harm includes Categories C and D events; and error, harm includes Categories E–I events.
† 2002 national MEDMARX data provided by U.S. Pharmacopeia, Center for Advancement in Patient Safety.
‡ Near miss definition: Any process variation or error that could have resulted in harm to a patient, visitor, or staff, but through chance or timely intervention did not reach the individual.
§ No harm definition: An event that reached the patient but did not result in harm.
** Harm definition: Impairment of the physical, emotional, or psychological function or the structure of the body and/or pain resulting therefrom.

Table 2. Number and percentage of inpatient and outpatient events, stratified by medication use process node and reported to the DoD Patient Safety Center Registry, October 2002 to September 2003, with comparison to the 2002 MEDMARX℠ national database

	Inpatient		Outpatient	
Process Node*	**DoD**	**National†**	**DoD**	**National**
Administering	1,710 (41%)	43,488 (35%)	381 (3%)	1,832 (13%)
Dispensing	1,058 (26%)	23,574 (19%)	8,942 (61%)	6,962 (51%)
Documenting/ transcribing	793 (19%)	30,124 (24%)	1,226 (8%)	1,124 (8%)
Monitoring	40 (1%)	1,399 (1%)	48 (< 1%)	113 (1%)
Prescribing	525 (13%)	26,703 (21%)	4,136 (28%)	3,683 (27%)

* Process node categories defined by the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP).
† 2002 national MEDMARX data provided by U.S. Pharmacopeia, Center for Advancement in Patient Safety.

The data reported to the DoD PSC showed that the largest percentage of outpatient events had occurred in the dispensing node (61 percent), followed by those errors that occurred in the prescribing node (28 percent), and those from the documenting/transcribing node (8 percent). The national data showed that the largest percentage of outpatient errors had occurred in the dispensing node (51 percent), followed by errors that occurred in the prescribing mode (27 percent), and those from the administering node (13 percent). Although the national and DoD datasets do contain differences, the error distributions compare closely.

Drug products involved in medication errors

An analysis of drug products involved in inpatient medication error reports was conducted and compared to the national data submitted to the MEDMARX system during CY 2002. Six of the top 10 drug products involved in errors that reached the patient were common to the DoD and national datasets. Moreover, 5 of the top 10 drug products included in both the DoD and national datasets are considered "high-risk/alert" drugs. Of the top 10 products involved in errors that resulted in patient harm, 7 were common to the DoD and national datasets. Additionally, 9 of the 10 leading "harm" drugs in the DoD data and 8 of the 10 leading "harm" drugs in the national data are considered "high-risk/alert" drugs (Table 3).

Types of error

The October 2002–September 2003 DoD medication events were compared to the CY 2002 national data from the MEDMARX system, after being categorized by type of error and stratified by the source of record (inpatient or outpatient) (Table 4). The most commonly reported type of inpatient error in the DoD data was "improper dose/quantity," followed by "omission error." The most commonly reported inpatient error in the national dataset was "omission," followed "improper dose/quantity." For both the DoD and national datasets, the most commonly reported outpatient error type was "prescribing error," followed by "improper dose/quantity." The inpatient and outpatient data from the DoD compare closely with the national data, despite differences in the collection procedures.

Table 3. Ranked top 10 inpatient products involved in errors that reached the patient, stratified by level of harm and reported to the DoD Patient Safety Center, October 2002 to September 2003, with comparison to the 2002 MEDMARX[SM] national database

Products that reached the patient (Categories C–I)		Products that caused harm (Categories E–I)	
DoD	National*	DoD	National*
Cefazolin	Albuterol	**Morphine Sulfate**	**Insulin**
Insulin†	**Insulin**	**Fentanyl**	**Morphine Sulfate**
Morphine Sulfate	**Heparin**	**Insulin**	**Heparin**
Oxycodone	**Morphine Sulfate**	**Meperidine**	**Potassium Chloride**
Vancomycin	Vancomycin	**Methadone**	**Hydromorphone**
Heparin	**Warfarin**	**Potassium Chloride**	**Warfarin**
Enoxaparin	Cefazolin	**Warfarin**	Enoxaparin
Potassium Chloride	Furosemide	**Diazepam**	**Fentanyl**
Ketorolac	**Potassium Chloride**	Furosemide	**Meperidine**
Metoprolol	Ipatropium	**Hydromorphone**	Vancomycin

* 2002 national MEDMARX data provided by U.S. Pharmacopeia, Center for Advancement in Patient Safety.
Note: Items in bold indicate high-risk/high alert medications.

Table 4. Percentage of inpatient and outpatient events, stratified by error type and reported to the DoD Patient Safety Center October 2002 to September 2003, with comparison to the 2002 MEDMARX℠ national database

	Inpatient		Outpatient	
Error type*	DoD	National†	DoD	National†
Deteriorated product	0.4%	0.04%	0.1%	0.04%
Expired product	0.6%	0.02%	0.2%	0.02%
Extra dose	7.0%	5.1%	1.3%	2.1%
Improper dose/quantity	23.0%	25.9%	30.9%	29.7%
Omission error	22.2%	27.1%	2.1%	6.9%
Prescribing error	8.3%	17.4%	33.3%	31.3%
Type not determined	10.8%	0.1%	9.2%	0.02%
Unauthorized drug	8.6%	10.7%	7.3%	12.6%
Wrong administration technique	1.8%	1.3%	0.6%	1.2%
Wrong dosage form	2.8%	1.5%	8.1%	7.1%
Wrong drug preparation	6.1%	3.7%	9.7%	8.1%
Wrong patient	4.6%	4.2%	8.1%	9.2%
Wrong route	1.2%	1.6%	0.5%	0.8%
Wrong time	8.0%	7.5%	1.0%	1.9%

* Error types as categorized and defined in the 2004 MEDMARX system.
† 2002 national MEDMARX data provided by U.S. Pharmacopeia, Center for Advancement in Patient Safety.

Actions taken

The MEDMARX reporting system includes an "actions taken" field in the medication error reporting form. Of the 29,662 error events reported by DoD facilities, 18,883 (64 percent) included at least one action taken related to the error. The most frequently reported action was "informed staff who made the initial error" (51.4 percent), followed by "education and training provided" (30.5 percent).

Discussion

Limitations

Caution should be used in drawing conclusions from the reported medication error information, as there are numerous data limitations, specifically in the comparisons of the DoD and national MEDMARX data. All data are voluntary and self-reported and may not be an accurate reflection of what is occurring in the individual DoD facilities. In fact, the reported data most likely represent a small percentage of the events that are occurring in the military health care system. While MEDMARX is an error reporting tool that can be used to track medication-related events and identify trends without regard for the means used to detect them, it should be noted that the DoD uses the system primarily as a spontaneous reporting network. Error detection and subsequent reporting should include

multiple strategies (e.g., observational methods, computerized triggers, retrospective chart review, and spontaneous reporting), so the USP and DoD have incorporated this emphasis into the MEDMARX training curriculum. Users are instructed on the use of MEDMARX in nontraditional active and passive surveillance contexts such as root-cause analyses (RCA), failure mode and effect analyses (FMEA), and other performance and quality improvement initiatives. Additionally, data reported to the DoD Patient Safety Center Registry and MEDMARX are considered nominal-style variables, and therefore only descriptive measures were used to present the findings. No additional statistical methods were employed in the analysis.

Another limitation concerns the MEDMARX program implementation and standardized data collection methods. During fiscal year (FY) 2003, many DoD health care facilities were implementing local patient safety programs, of which MEDMARX was a part. As such, challenges arose involving reporting accuracy, timeliness, and completeness of the data.[12] Many of these concerns have been identified and are being addressed in training at the local, service, and DoD levels.

The 2002 MEDMARX national data used in comparisons with the DoD data reported to the PSC is an additional area of concern. Ideally, data from identical time frames would have been used to compare the DoD data and the MEDMARX national data, but in this instance simultaneous data collection was not possible. Additionally, the 2002 DoD data could not be removed from the national dataset; and it is not known what, if any, impact this redundancy had on the overall analysis. It is important to note that neither DoD nor MEDMARX make any attempt to establish rate-based indicators or normative reporting ranges, and that the comparisons were included for illustrative purposes only.

Application of the data

It is necessary to emphasize again that the present DoD data are preliminary. However, the significance of this data should not be minimized. In fact, medication error data submitted to the DoD PSC have been used to identify, justify, and support several military-wide initiatives. For the first time, the DoD can aggregate medication error data at multiple levels and identify potential trends at the service and DoD levels that may not be apparent at the health care facility level. This analysis suggests that DoD facilities are faced with medication safety challenges similar to those of their civilian counterparts; the leadership should not wait for trends to emerge in their own data before taking action. Similarities in the DoD and national MEDMARX data on drug products that resulted in harm to patients appear to support this assessment. This type of information now is shared routinely with senior leadership at the headquarters and facility levels, via the PSC's quarterly and annual data summary reports. More detailed analyses will be possible in the future, once the MTFs have completed the program implementation and the training initiatives, data quality, and integrity issues have improved.

Safety publications

In addition to locally collected event data, facilities and health systems should make a point of using information gathered from several other reliable sources, in an effort to better understand the global medication error trends in health care. Organizations such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the ISMP have identified numerous medication error patterns and corresponding strategies for reducing errors that could benefit all clinical facilities.[13] Two publications were developed using these nationally recognized safe practice recommendations and error report data submitted to the DoD PSC. The first of these publications, *DoD Patient Safety Hot Topics,* was created as a support tool for patient safety officers and is intended to address patient safety issues identified in event reports or derived from other reputable patient safety resources. The second publication, *DoD Patient Safety Alert,* serves as a rapid dissemination instrument for priority alerts directed at the MTFs and is used to distribute topical items identified from the services, nationally recognized patient safety organizations, and the Patient Safety Center Registry. In fall 2003, for example, the DoD PSC received a near-miss report regarding a potentially unsafe practice involving 30 ml multidose vials (MDV) of epinephrine. In response to the perceived safety threat, the PSC released its first *DoD Patient Safety Alert* in January 2004, detailing the hazard, as well as the nationally recognized "best practice" recommendations for the storage and use of 30 ml epinephrine vials. News in subsequent safety alerts and issues of *Hot Topics* addressed topics such as high-alert medications, dangerous abbreviations, look-alike insulin and tuberculin syringe packaging, the paucity of patient allergy documentation, improper patient identification, and intravenous line and enteral feeding tube mix-ups.

Reporting to external agencies

The DoD PSC occasionally receives error event reports that relate directly to pharmaceutical manufacturer product packaging and labeling. Once all the relevant product and manufacturer information has been gathered, it is summarized in a report sent to the USP MER program and the FDA's MedWatch program. The USP reviews each report for health hazards and forwards its findings to the FDA and the product manufacturer, in an effort to better maintain the reporter's confidentiality.[4, 5] To date, the PSC has submitted dozens of reports to these agencies as a means of improving the packaging and labeling of pharmaceutical industry products.

Lessons learned

Reporting systems such as MEDMARX can be valuable tools for collecting and managing data related to medication delivery. The usefulness of such tools, however, is dependant upon the quality of the data being collected. It is therefore essential that the entered information be as accurate, complete, and timely as possible. Like other reporting systems, MEDMARX is vulnerable to the

"garbage-in, garbage-out" syndrome. Core elements including a thorough implementation plan, a robust training program, strategies for timely system changes, and sufficient program resources should be in place to improve the likelihood of program success at all levels. Weaknesses in any one of these areas may compromise data quality within the individual facility, the health system, and other users of the MEDMARX national database.

Implementation

Perhaps the most important lessons to come out of this program have involved the implementation of a standardized reporting program. Although the military health care system is similar in many respects to other large health systems, several important distinguishing characteristics of the MHS make implementation a complex and challenging task—factors such as the high active duty personnel turnover rate, worldwide military hospital locations, and staff mobilizations in times of war and other crises. Individual hospitals have limited resources and a variety of competing requirements, so it is important for the leadership at facilities to possess a clear understanding of new initiatives, as they unfold.

The MEDMARX reporting system was introduced in DoD facilities as an optional tool in early 2002; however it was not until March 2004 that use of MEDMARX became mandatory in all the services. As a result, patient safety managers and pharmacists at various hospitals and clinics decided how best to utilize the MEDMARX system. And while some facilities embraced it, others chose to use it only within the pharmacy, or not at all. Since policy letters were issued mandating the use of MEDMARX, there has been a positive trend in the use of the system.

Education and training

Another valuable-but-difficult lesson for the DoD involved staff education and training in the use of the MEDMARX reporting system. Generally speaking, a well-defined and detailed training program can have a positive effect on any new program. The MEDMARX training staff at USP and the DoD recognized this early on; however funding and other resources to support such activities were not immediately available. A training budget was included in the DoD MEDMARX central contract that went into effect in October 2003. Moreover, USP developed and launched an online tutorial designed for new MEDMARX users in March 2003, and a team of USP and DoD instructors currently offers advanced MEDMARX training at various U.S. military bases throughout the country and at USP headquarters in Rockville, Maryland. Response to the training sessions and its inherent value has been very positive. Future training sites may include military bases in Europe and the Far East.

System improvements

The impetus to standardize the collection and analysis of patient safety information is a relatively recent occurrence. Although most agree that these collection efforts are important, no nationally recognized standard encompassing

the critical elements and taxonomy has yet been established. Furthermore, data elements and collection methodologies have matured and evolved significantly since the release of *To Err Is Human* in 1999. As a result, developers of medical event reporting systems should be flexible in their inclusion of new information technology, reflect advances in patient safety research, and be responsive to user feedback. The USP has incorporated numerous changes to the MEDMARX system since it was launched in 1998. More than 70 system improvements have occurred just since 2002, including the graphical user interface redesign, significant enhancements to improve search functionality, the development of an online training tutorial, and expanded categories and fields. Many of these changes were a direct result of the user feedback received at USP.

Conclusions

Medication errors account for a large percentage of total error events reported at military health care facilities. The implementation of the MEDMARX electronic reporting system has enhanced the DoD's ability to collect and analyze these events. Although the challenges associated with the implementation of a standardized error reporting system were considerable in number and scope, the long-term benefits to the DoD are significant.

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